Lab 6: Magnetic Fields

Names:
1.) ______________________________
2.) ______________________________
3.) ______________________________

Learning objectives:

- Observe shape of a magnetic field around a bar magnet (Iron Filing and magnet)
- Observe how static charged objects interact with magnetic fields
- Investigate the magnetic field around a coil of current carrying wire
- Explore the interaction of currents and permanent magnets
- Explore the path of a moving electron in a uniform magnetic field
- Observe that a changing magnetic field can produce a voltage (Magnet in and out of coil)

Activities:

- Map Field of Permanent Magnet
- Attraction of Paper Clips
- Interaction of a stationary charged object with a with magnet
- Look at the forces involved with a magnet and current carrying wire
- Magnetic Field of a solenoid
- Moving magnet in a coil and moving coil near a magnet
- Build a speaker from the items on the table

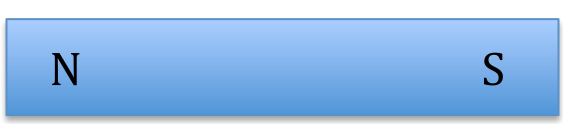
Warm-Up: Qualitative Magnetic Field Maps

1. Here a few applets to help visualize magnetic fields

a. http://phet.colorado.edu/en/simulation/magnet-and-compass
b. http://phet.colorado.edu/en/simulation/faraday
c. http://www.kcvs.ca/site/projects/physics.html

How does a compass work? Which side of the compass points toward the Geographic North pole?

2. Place the blue and red magnet under the paper plate. Slowly sprinkle iron filings into the dish and observe the pattern that emerges. It may help to tap on the dish a little bit. Draw the pattern you observe below.



Use the compass provided to explore the field around the magnet as well.

2.) Can you figure out which side of the magnet is North and South?

3.) Try picking up a chain of paper clips with a magnet. How does this work?

4.) Why can a magnet stick to a refrigerator door?

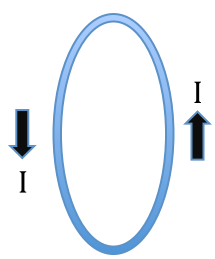
Magnetic Fields and Stationary Charges

5.) Prediction: What will happen if you place a charged rod near a compass needle? Fill in your predictions below BEFORE you try the experiment.

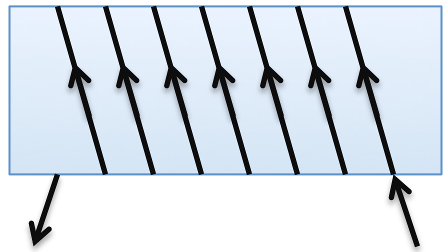
Charge on Rod	Compass Needle reaction (Attracts North pole, Attracts South pole, Attracts both North and South Poles, No Attraction)
Neutral rod	
Charge Plastic (negative) by rubbing with fur	
Charge Glass (Positive) by rubbing with Silk	

Magnetic Fields and Moving Charges

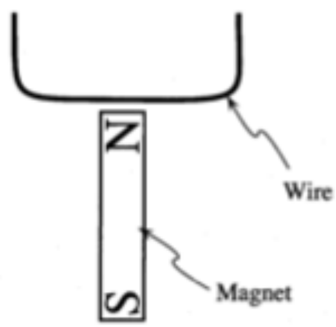
6.) Extend the idea of a magnetic field around a single current carrying wire to a wire that is wound into a single loop. Draw what this field might look like.



7.) The TF will do a demonstration of a current carrying solenoid. This consists of a DC power supply to pass a current through the wire shaped in coil. They will sprinkle some iron filings around the coil. Draw the resulting magnetic field below.



8.) On an enlargement of the figure below, sketch field lines representing the magnetic field of the bar magnet. Show the field both inside and outside the magnet.



Let's assume that positive current flows through the wire from left to right..

Predict the direction of the force exerted on the wire by the magnet when the circuit is complete. Explain.

Check your prediction. (Do not leave the power supply connected for more than a few seconds. The power supply and wires will become hot if the circuit is complete for too long.

Make predictions for the following five situations based on what you observed in part A. Check your answers only after you have made all five predictions.

A.) The magnet is turned so that the south pole is near the wire while the battery is connected.

Prediction:

Observation:

B.) The leads to the battery are reversed (consider both orientations of the magnet).

Prediction:

Observation:

C.) The north pole of the magnet is held near the wire but the battery is not connected.

Prediction:

Observation:

D.) The north pole of the magnet is held: (a) closer to the wire and (b) farther from the wire.

Prediction:

Observation:

E.) The magnet is turned so that it is parallel to the wire while the battery is connected.

Prediction:

Observation:

Resolve any discrepancies between your predictions and your observations. *(Hint:* Consider the *vector equation* for the magnetic force on a current-carrying wire in a magnetic field: $F = iL \times B$.*)*

F.) Replace the black hanging wire with the yellow coil. Explain what is happening?

9.) The TF's will show a quick demonstration of an electron being shot into a uniform magnetic field. Explain what is happening using diagrams and words. X=into the page, O=out of the page.

10.) Attach the solenoid on the wood frame to the black galvanometer (sensitive ammeter). Can a magnet interact with the solenoid so that a current (deflection on the meter) is produced? Describe what you needed to do to produce a current.

11.) Try the same thing, but with the yellow coil. This time you can manipulate the solenoid and see how the current changes. Comment on the changes that occur. Try:

A.) Fewer coils

B.) More coils

C.) Coils change size in the presence of a magnetic field

12.) Challenge problem:

A speaker takes an alternating electrical signal of recorded music and converts it to sound. Using the headphone output of the computer, and an amplifier to increase the signal strength, can you assemble a crude speaker with the materials available on the table.